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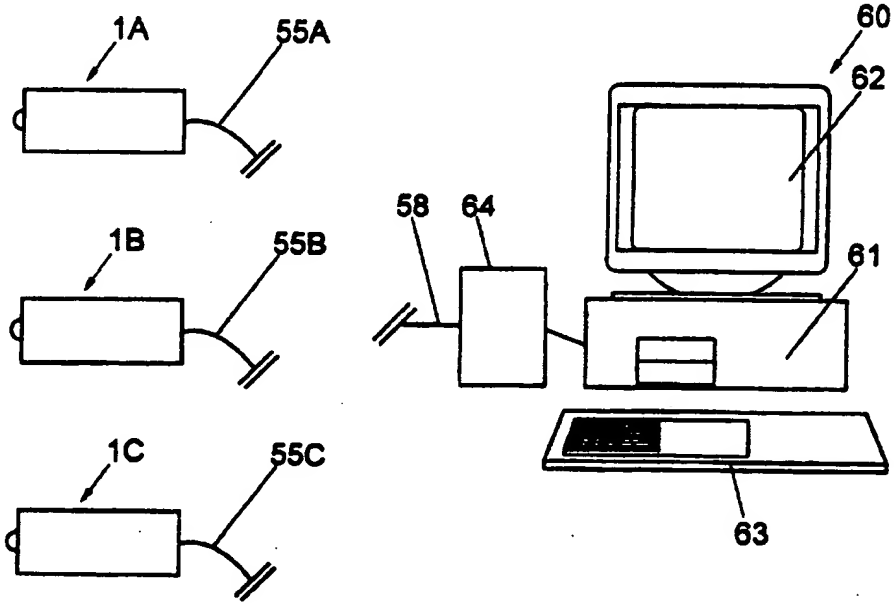

(57) Abstract

A front end unit (1) for use in an imaging system comprises a camera (10) to provide an image, a digitiser (20) to convert the image into digital data, a data processor (30) for manipulation and/or storage of the digitised image, and a modem (40) for rendering the digitised image suitable for transmission by telephone network. The camera, digitiser and data processor, and preferably the modem, are provided within a single housing (5). The elements are dedicated, enabling the housing to be made small. The unit is preferably suitable for connection direct to a telephone socket. A system including a remote host computer for receiving images from one or more front end units is also provided.

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IMAGING SYSTEM

The present invention relates to an imaging system and especially to an imaging system including the transmission of images via a telephone network.

The transmission of digitised information which represents images, via a telephone network, is known and is commonly performed. Such transmission typically involves a first sophisticated computer, equipped with a modem, at a first end of a telephone line and a second sophisticated computer equipped with a modem, at a second end of the telephone line. Where the aim is to capture images in the vicinity of the first computer, a video camera is typically connected to the first computer and data representing images captured by the camera are transmitted via the telephone line to the second computer. Systems are known in which several cameras may be connected to the first computer which may then transmit, via a modem, data representing images from one or more of the cameras, to the second computer. In such systems additional hardware such as multiplex units may be required for use with the first computer.

According to a first aspect of the present invention there is provided a front end unit for use in an imaging system said front end unit comprising: camera means to provide an image; digitisation means to convert said image into digital data; data processing means; modem means for rendering said digital data suitable for transmission by telephone network, wherein said camera means, said digitisation means and said data processing means are provided within a single housing.

Preferably, said modem means is also provided within said single housing.

Preferably, said digitisation means is dedicated for use in said front end unit.

Preferably, said data processing means is dedicated for use in said front end unit.

Preferably, said modem means is dedicated for use in said front end unit.

Preferably, the camera means comprises a video camera.

Preferably, the front end unit includes data compression means.

Preferably, the modem means comprises a modem for use with ISDN, PSTN or network telecommunications systems.

Preferably, the front end unit includes a transmitter for connection to a cellular telephone system or other wireless telegraphy system.

Preferably, the data processing means includes a frame

grabber.

Preferably, the housing is not greater than about 15cm by 15cm by 25cm in size.

Preferably, the front end unit includes two spaced apart camera means each adapted to provide an image from a slightly different view point, enabling a three dimensional interpretation of the data provided by said front end unit.

Preferably, the front end unit includes input means for receipt of an image signal from a second or subsequent front end unit, and at least one of the digitisation means, data processing means and modem means acts upon the image signal from the second or subsequent front end unit.

According to a further aspect of the present invention there is provided an imaging system including at least one front end unit in accordance with the first aspect.

Preferably, the imaging system further includes a host unit comprising a computer and a modem, said host unit being located remote from said front end unit and adapted to communicate with the front end unit via a telephone connection.

Preferably, said host unit includes display means and is adapted for displaying images communicated from the front end unit.

Preferably, the host unit includes data storage means for storing data relating to images communicated from the front end unit.

Preferably, the host unit includes means for manipulating or analysing images.

Preferably, the host unit includes means for selectively interrogating one of a number of front end units by communicating with said selected front end unit via a corresponding selected telephone connection.

Preferably, the front end unit is adapted to initiate communication with the host unit in response to a triggering signal, or alarm signal, generated in response to a stimulus in the vicinity of the front end unit.

Preferably, the imaging system comprises:

a first front end unit in accordance with the first aspect of the present invention, the first front end unit including input means for receipt of an image signal from a second or subsequent ront end unit;

at least one second or subsequent front end unit, in the vicinity of the first front end unit, without at least one of a digitisation means, data processing means or modem means, and wherein the system is adapted to relay images from the second or subsequent front end unit to the host unit by utilising the digitisation means, data processing means and/or modem means of the first front end unit.

According to a further aspect of the present invention, there is provided a method of stock control including: use of a plurality of spaced apart front end units in order to provide images from which stock levels in corresponding spaced apart areas can be determined.

The method of stock control may further comprise use of a remote host unit to selectively interrogate a first

one of said plurality of front end units and to receive one or more images from said selected front end unit from which the stock level at the corresponding area may be determined.

The method may further comprise using the host unit to subsequently interrogate a second one of said plurality of front end units and to receive one or more images therefrom.

Preferably, the host unit runs stock control/ordering software simultaneously with software enabling the interrogation of the front end units and interpretation of data received from said front end units.

Preferably, the use of the host unit to interrogate a selected front end unit comprises the host unit initiating connection to the front end unit by selection of a telephone connection which corresponds to the selected front end unit.

Embodiments of the present invention will be described, by way of example, with reference to the accompanying drawings in which:

Fig. 1a is a schematic illustration of an embodiment of a front end unit for use in an imaging system in accordance with the present invention;

Fig. 1b is a front view of the front end unit of Fig. 1a;

Fig. 2 is a schematic illustration of an imaging system showing three mutually remote front end units and one host unit.

Fig. 3 is a schematic illustration of an alternative embodiment, showing four camera units in the same vicinity with shared data processing means and modem in the same housing as one of the cameras;

Fig. 4a is a schematic illustration of an embodiment of a front end unit having two adjacent cameras;

Fig. 4b is a front view of the front end unit of Fig. 4a; and

Figs. 5 and 6 provide technical details of embodiments of front end units in accordance with the present invention.

With reference to Figs. 1a and 1b a front end unit 1, for use in an imaging system, comprises camera means in the form of a compact high-resolution colour video camera 10, digitisation means 20 for digitising the image provided by said video camera 10, data processing means 30 and modem means in the form of a dedicated modem 40, all housed in a compact housing 5. The housing 5 is provided with a first aperture 6 at a first end thereof through which light may reach a lens 12 of the video camera 10. The housing 5 is provided with a second aperture at the second end thereof which allows access to a socket 50 suitable for connection to a telephone line.

The use of dedicated digitisation means 20, data processing means 30 and modem 40 enables these components to be constructed such that they are extremely economical to produce and small in size. A compact camera 10 is also used enabling the size of the front end unit to be restricted to approximately the same size as a conventional video camera.

Fig. 2 illustrates an imaging system having first, second and third remotely located front end units 1A, 1B, 1C. The front end units 1A, 1B, 1C may be in different cities or different countries and each is connected to a respective telephone line 55A, 55B, 55C via which connection to a telephone network can be achieved. The system also includes a host unit, generally designated 60 comprising a host computer 61 having output means, for example in the form of a display screen 62, input means, for example in the form of a keyboard 63 and modem means 64 connected to a telephone line 58 via which connection to a telephone network can be achieved. The host unit 60 can be used to interrogate any of the front end units 1A, 1B, 1C via the telephone network merely by accessing the telephone line 55A, 55B, 55C corresponding to the desired front end unit 1A, 1B, 1C. Typically, therefore the host unit will have a database of telephone numbers, each corresponding to a different front end unit. The host unit 60 can be used to manipulate the images received, for example enlarging selected parts of said images.

The interrogation by the host unit may be high level as commands sent by the host unit can be interpreted by the respective data processing means 30 in each front-end unit. The functions of the front end unit may thus be controlled by the host unit, and the host unit may also control front end mechanical devices (not shown), such as means for selectively orienting or adjusting the position of said front end unit.

It will be appreciated that the front end units 1A, 1B, 1C may be arbitrarily remote from each other and from the host unit 60 provided that the host unit 60 and the front end units 1A, 1B, 1C are connectable to a

telephone network. In a variation of this embodiment one or more of the host unit and front end units may include transmission means for wireless telegraphy of a signal (such as is known from cellular telephone technology) and may thus operate, and transmit or receive images, in locations where no hard wired telephone lines (or other image transmission lines) exist.

Each unit also requires a source of electrical power (not shown) and this will normally comprise connection to electrical mains. However, portable or stand alone electrical power sources could be used, for example batteries or electricity generating means. Thus one or more front end units may be fully portable. The host unit, for example in the form of a lap-top computer connected to a cellular telephone network, may also be fully portable. A fully portable host unit may be of particular value in enabling mobile emergency services to view a remote target area, such as the scene of a fire or crime, while travelling to said area.

The embodiment illustrated in Fig. 2 provides an economical way of providing video images from arbitrarily spaced apart areas to a host unit user. Furthermore, the front end units being small and self contained (except perhaps for power and telephone connection lines) are easy to position, unobtrusive, non-invasive, robust and interference-resistant.

An envisaged use for such a system is for stock control in the circumstances where a supplier is responsible for maintaining stocks of his product in a number of retail establishments. One or more front end units would be provided in the stock storage area of each retail establishment and positioned so that the images

provided show the level of stock of the supplier's product in each establishment. The supplier can then check the level of stock in each location from a remote host unit. Stock control and ordering software could be run on the host unit simultaneously with imaging software and a user can therefore view the retailer details, ideal stock levels etc as well as the image showing the actual stock levels and, if required, immediately requisition further stock. This system is much more efficient than a system requiring travel to, and manual inspection of stock at, each retail outlet. The enhanced efficiency would enable rapid recovery of the capital expenditure involved in installing such a system.

Embodiments of systems in accordance with the present invention may be beneficially used in applications other than stock control, and there are many applications in which it is desirable to access visual images from remote locations. Applications include: monitoring of industrial processes, for example in oil and gas production; industrial line inspection; security surveillance; fire monitoring; traffic and motorway surveillance; automated telling machine surveillance; customer monitoring; vision control and personal property monitoring. The host unit may display images enabling a user to inspect the images and decide on and initiate an appropriate course of action. Alternatively, the host unit may run software to enable automatic analysis of the images and initiation of data logging or action to be taken. For example a system having a suitably positioned front end unit could be used to automatically recognise and log the registration details of all vehicles entering or leaving a given area.

A variation of an embodiment of a system in accordance with the present invention includes front end units which, rather than waiting to be interrogated by the host unit, initiate communication with the host unit and transmission of images in response to a stimulus in the vicinity of the front end unit. The stimulus may be provided by, for example, a burglar alarm system, a fire detection system, motion detection system etc. The alarm or other means of providing stimulus could be external to the front end unit or included as part of the front end unit.

A host unit may be provided with a number of telephone lines for simultaneous communication with a number of front end units. In this case the host system may use a split screen display to simultaneously display images from a number of front end units.

There are applications in which a number of cameras are provided in close proximity. In such applications it is possible to provide a number of front end units each including a camera 10, digitisation means 20, data processing means 30 and a modem 40, and for some applications (such as where damage to front end units is likely) the high level of redundancy that this provides is desirable. In applications where such redundancy is not required a cost saving can be obtained by providing a number of front end units each of which include a camera but which have some shared components.

Fig. 3 shows a first front end unit 101 including a camera 10, digitisation means 20, data processing means 30 and a modem 40. The first front end unit also includes a plurality of input sockets 108 enabling connection to second and subsequent front end units,

shown in the illustrated embodiment as second, third and fourth front end units 101A, 101B, 101C. The second, third and fourth front end units 101A, 101B, 101C each include a camera 110A, 110B, 110C, digitisation means 120A, 120B, 120C and output means 125A, 125B, 125C for connection to the sockets 108 of the first front end unit. The second, third and fourth front end units 101A, 101B, 101C do not include data processing means or a modem but instead rely upon these elements of the first front end unit 101 for transmission of images to a host unit (not shown).

Systems could include an arbitrary number of second and subsequent front end units which rely upon components housed in a first front end unit for image transmission. The second and subsequent front end units could be provided without digitisation means, in which case they would transmit analogue image signals to the first front end unit for digitisation by the digitisation means provided therein.

Although in the above description the camera means, digitisation means, data processing means and modem means have been described, for convenience, as separate entities, it is of course possible for two or more of these elements to be in the form of a single component. For example, cameras which provide digital output could be provided.

The data processing means may include a considerable data storage capacity. This allows, for example, storage of images taken over an extended period, for downloading to a host unit during a relatively short connection time. This enhances efficiency and allows pre-event images to be retrieved even if it is only decided that they are required after the event has

occurred. This is of particular value in a system in which transmission of images is triggered by an alarm (such as a fire alarm or security alarm) in the vicinity of the front end unit, as it allows access to images leading up to the event that triggered the alarm. A preferred embodiment therefore comprises a front end unit in which images are constantly written to memory. Stored images preferably include time, date and/or camera location information.

Fig. 4a shows schematically a front end unit 401 having first and second video cameras 410A, 410B within a single housing 405. The front end unit 401 includes respective first and second digitisation means 420A, 420B for the first and second video cameras 410A, 410B. The front end unit 401 also includes data processing means 430 and modem means 440 to enable connection to a telephone network. Fig. 4b shows a front view of the front end unit 401. The objective lenses 412A, 412B of the first and second video cameras 410A, 410B are spaced apart by a fixed distance and thus provide images from slightly different viewpoints. By using known techniques this enables construction of a three dimensional model of the images in the host unit (not shown).

Figs. 5 and 6 provide details of technical data relating to preferred embodiments of a front end unit.

Embodiments of the present invention provide a compact, economical front end unit suitable for connection direct to a telephone socket. This enables an imaging system, for transmission of images from a number of arbitrarily distant front end units to an arbitrarily distant host unit, to be provided extremely economically with a minimum of hard-wiring. A desired

front end unit can be interrogated merely by selecting a corresponding telephone number from the host unit.

Modifications and improvements may be incorporated without departing from the scope of the invention, and elements hereinbefore described could be replaced by functional equivalents thereof.

CLAIMS

1. A front end unit for use in an imaging system said front end unit comprising:

camera means to provide an image;

digitisation means to convert said image into digital data;

data processing means;

modem means for rendering said digital data suitable for transmission by telephone network, wherein said camera means, said digitisation means and said data processing means are provided within a single housing.

2. A front end unit according to Claim 1, wherein said modem means is also provided within said single housing.

3. A front end unit according to either preceding claim, wherein said digitisation means is dedicated for use in said front end unit.

4. A front end unit according to any preceding claim, wherein said data processing means is dedicated for use in said front end unit.

5. A front end unit according to any preceding claim, wherein said modem means is dedicated for use in said front end unit.

6. A front end unit according to any preceding claim, wherein the camera means comprises a video camera.

7. A front end unit according to any preceding claim, wherein the front end unit includes data compression means.

8. A front end unit according to any preceding claim, wherein the modem means comprises a modem for use with ISDN, PSTN or network telecommunications systems.

9. A front end unit according to any preceding claim, further including a transmitter for connection to a cellular telephone system or other wireless telegraphy system.

10. A front end unit according to any preceding claim, wherein the data processing means includes a frame grabber.

11. A front end unit according to any preceding claim, wherein the housing is not greater than about 15cm by 15cm by 25cm in size.

12. A front end unit according to any preceding claim, including two spaced apart camera means each adapted to provide an image from a slightly different view point, enabling a three dimensional interpretation of the data provided by said front end unit.

13. A front end unit according to any preceding claim, having input means for receipt of an image signal from a second or subsequent front end unit, and wherein at least one of the digitisation means, data processing means and modem means acts upon the image signal from the second or subsequent front end unit.

14. An imaging system including at least one front end unit according to any preceding claim.

15. An imaging system according to Claim 14, further including a host unit comprising a computer and a modem, said host unit being located remote from said

front end unit and adapted to communicate with the front end unit via a telephone connection.

16. An imaging system according to Claim 15, wherein said host unit includes display means and is adapted for displaying images communicated from the front end unit.

17. An imaging system according to either of Claims 15 or 16, wherein the host unit includes data storage means for storing data relating to images communicated from the front end unit.

18. An imaging system according to any of Claims 15 to 17, wherein the host unit includes means for manipulating or analysing images.

19. An imaging system according to any of Claims 15 to 18, wherein the host unit includes means for selectively interrogating one of a number of front end units by communicating with said selected front end unit via a corresponding selected telephone connection.

20. An imaging system according to any of Claims 15 to 19, wherein the front end unit is adapted to initiate communication with the host unit in response to a triggering signal, or alarm signal, generated in response to a stimulus in the vicinity of the front end unit.

21. An imaging system according to any of Claims 15 to 20, comprising:

a first front end unit according to Claim 13;

at least one second or subsequent front end unit, in the vicinity of the first front end unit, without at least one of a digitisation means, data processing

means or modem means, and wherein the system is adapted to relay images from the second or subsequent front end unit to the host unit by utilising the digitisation means, data processing means and/or modem means of the first front end unit.

22. A method of stock control including:

use of a plurality of spaced apart front end units according to any of Claims 1 to 13, in order to provide images from which stock levels in corresponding spaced apart areas can be determined.

23. A method of stock control according to Claim 22, further comprising use of a remote host unit to selectively interrogate a first one of said plurality of front end units and to receive one or more images from said selected front end unit from which the stock level at the corresponding area may be determined.

24. A method of stock control according to Claim 23, further comprising using the host unit to subsequently interrogate a second one of said plurality of front end units and to receive one or more images therefrom.

25. A method of stock control according to either of Claims 23 or 24, wherein the host unit runs stock control/ordering software simultaneously with software enabling the interrogation of the front end units and interpretation of data received from said front end units.

26. A method of stock control according to any of Claims 23 to 25, wherein the use of the host unit to interrogate a selected front end unit comprises the host unit initiating connection to the front end unit by selection of a telephone connection which

corresponds to the selected front end unit.

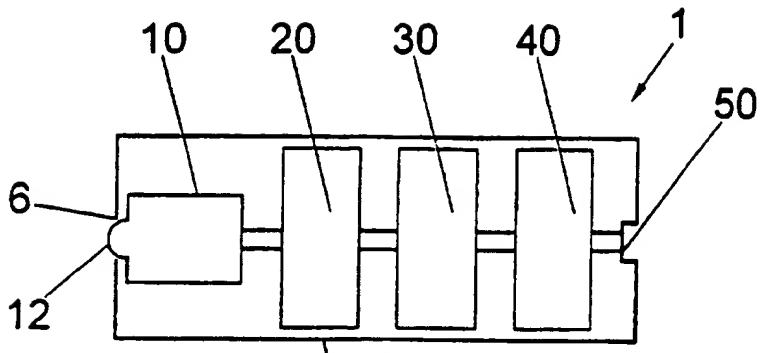

Fig. 1a

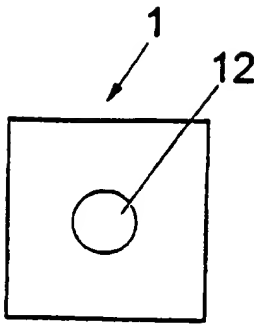

Fig. 1b

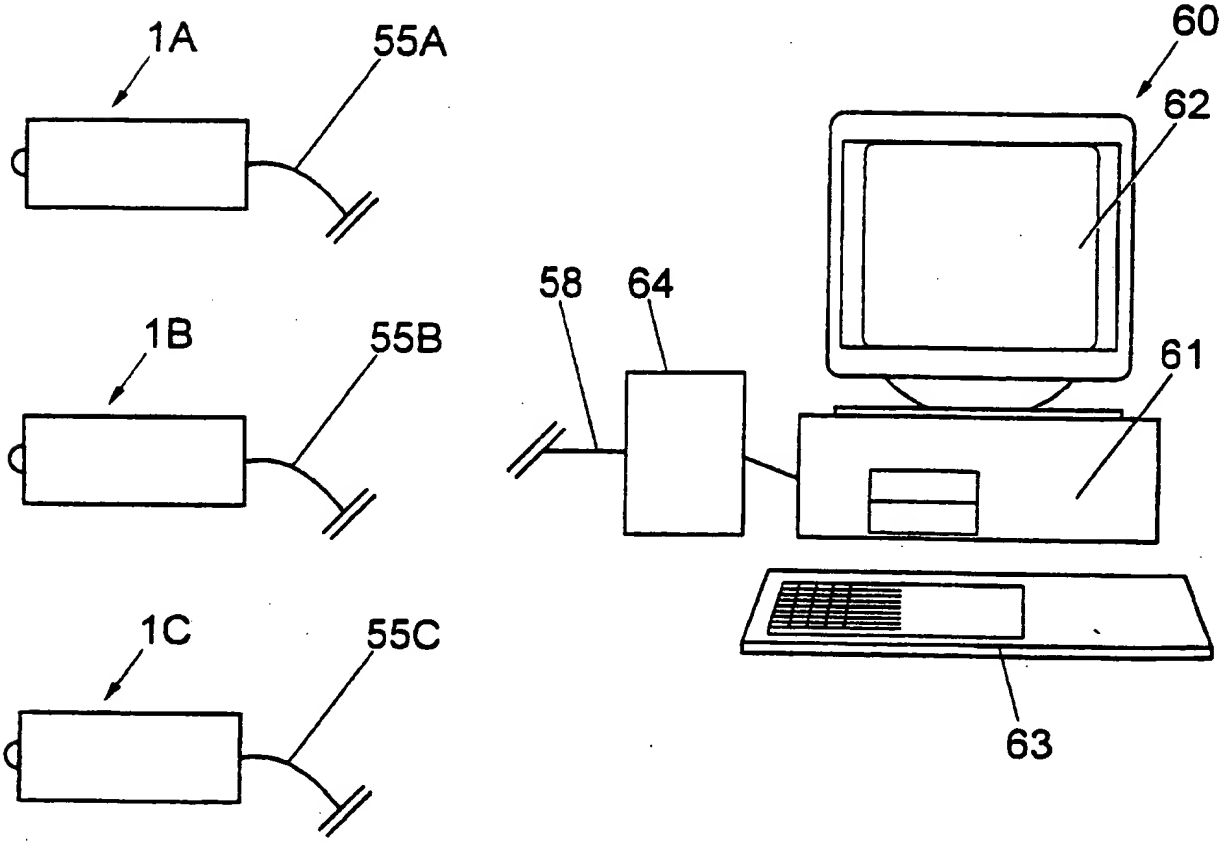

Fig. 2

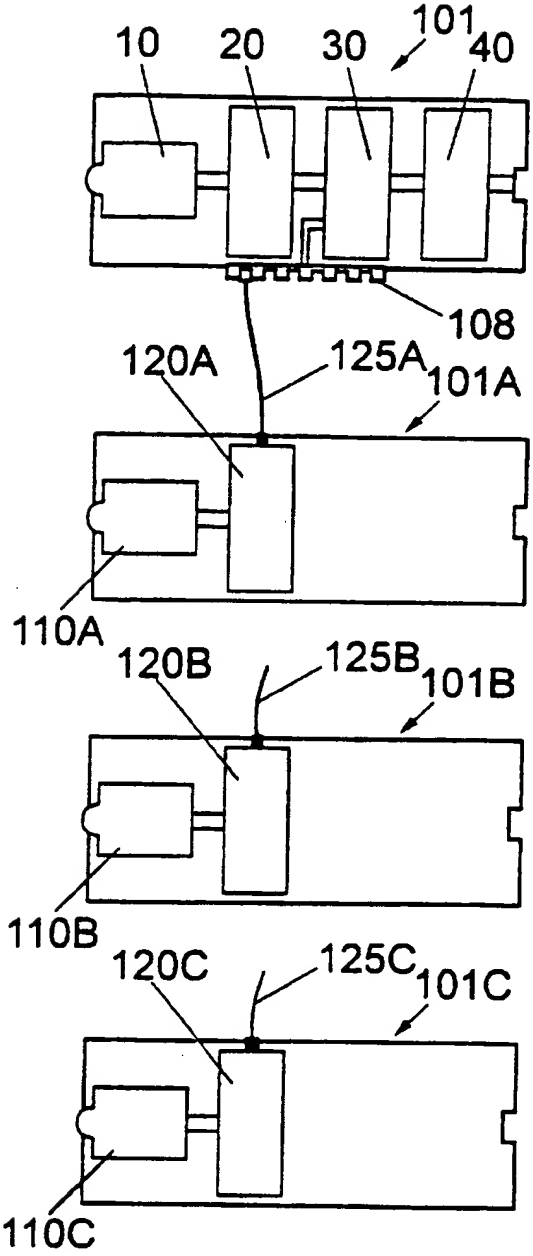

Fig. 3

Fig. 4a

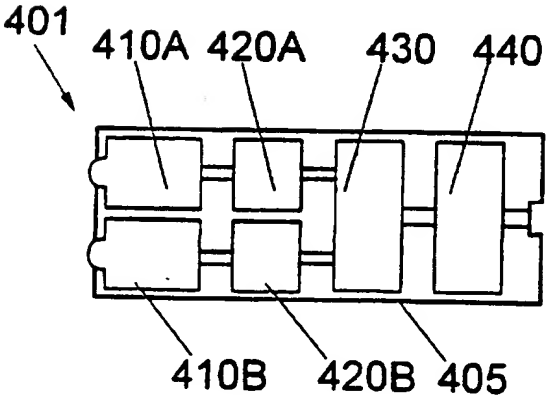

Fig. 4b

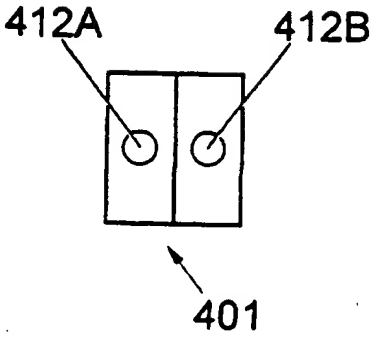

Fig. 5

TECHNICAL SPECIFICATION

CAMERA MODULE		
Sensor Type	Colour CCD	
Image Sensor Area	Total Pixel	795(H) x 596(V)
	Effective Pixel	792(H) x 582(V)
Resolution	Horizontal	470TV Lines
	Vertical	580TV Lines
VIDEO CAPTURE MODULE		
Resolution		768(H) x 576(V)
Video Inputs	Six analogue inputs (six times CVBS or three times Y/C, or combinations)	
Video Output Format		4:2:2 YUV, 16 Bit
Video Memory		512K x 16 Bits
CONTROLLER MODULE		
CPU	Am188EM	8-bit controller
Program Memory	Flash Memory	512 x 8-bits
System RAM	SRAM	128 x 8-bits
Watchdog Timer	within the Am188EM Automatically resets the microcontroller CPU in case of hang up	
Serial Interface	For test and Diagnostics	
Parallel Interface	Four inputs, four Outputs	
Real Time Clock	Date and Time information managed through a RTC device connected to a rechargeable lithium battery.	
Power Management	RAM within the device to reduce power consumption, a sleep module is provided which turns off power to the Camera and Video Capture Modules. When sleep mode is active, power is automatically switched to the Camera Video Capture Modules on receipt of an incoming call or a change in condition of one of the parallel inputs.	
COMMUNICATION MODULE		
ISDN	ISDN 2 DSSI European Standard Protocol	128 Kbits/sec
PSTN/PCMCIA module available		
Network/PCMCIA module available		
POWER SUPPLY		
Supply Type	Switched Mode	
Outputs Provided	+5v, +12V, -12V	
Maximum Load	20 Watts	
SYSTEM DETAILS		
Power Requirements	120 V ac or 240 V ac	
Power Consumption	Approximately 12 Watts maximum	
EXTERNAL CONNECTIONS		
ISDN	RJ45 Socket	
Serial/Parallel	25 Pin D-Type Connector	
External Video	75R BNC	

Fig. 6

TECHNICAL SPECIFICATION

CAMERA MODULE		
Sensor Type	Colour CCD	
Image Sensor Area	Total Pixel	795(H) x 596(V)
	Effective Pixel	752(H) x 582(V)
Resolution	Horizontal	470TV Lines
	Vertical	580TV Lines
Lens Type	Integrated 4mm lens	
VIDEO CAPTURE MODULE		
Resolution		768(H) x 576(V)
Video Inputs	Six analogue inputs (six times CVBS or three times Y/C, or combinations)	
Video Output Format		4:2:2 YUV, 16 Bit
Video Memory		512K x 16 Bits
CONTROLLER MODULE		
CPU	32 bit Processor	486 DX
Program Memory	DRAM	4 M Bytes
System RAM	DRAM	4 M Bytes
Image Storage	Hard Disk	1 GB, 4 GB
Watchdog Timer	Automatically resets the CPU in case of hang up	
Serial Interface	For test and Diagnostics	
Parallel Interface	Four inputs, four Outputs	
Real Time Clock	Date and Time Information	
COMMUNICATION MODULE		
ISDN	ISDN 2 DSSI European Standard Protocol	128 Kbits/sec
PSTN/PCMCIA module		33.6 Kbits/sec
Network module available		Handset dependent
POWER SUPPLY		
Supply Type	Switched Mode	
Outputs Provided	+5v, +12V, -12V	
Maximum Load	20 Watts	
SYSTEM DETAILS		
Power Requirements	120 V ac or 240 V ac	
Power Consumption	Approximately 12 Watts maximum	
EXTERNAL CONNECTIONS		
ISDN	RJ45 Socket	
Parallel	25 Pin D-Type Connector	
Serial	9 Pin D-Type Connector	
External Video	15 pin D-Type Connector	

INTERNATIONAL SEARCH REPORT

Internat Application No
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A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 H04N7/14

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 H04N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	GB 2 274 044 A (CHATER JOHN CHARLES ;CHATER IAN (GB); CHATER GUY (GB)) 6 July 1994 see page 7, line 11 - page 9, line 3 see figures 1-9 ---	1,3-8, 13-19, 21-26
X	NTT REVIEW, vol. 6, no. 4, 1 July 1994, pages 70-78, XP000460340 HIROYUKI MATSUI ET AL: "AN ISDN BASIC INTERFACE VIDEOPHONE" see the whole document ---	1-8,10, 11,13, 14,22
X	EP 0 500 091 A (HITACHI LTD) 26 August 1992 see page 7, column 10, line 10 - page 12, column 19, line 46 see figures 1-13 -----	1-8, 12-14

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
31 July 1997	07.08.97

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+ 31-70) 340-2040, Tx. 31 651 epo nl, Fax (+ 31-70) 340-3016	Van der Zaal, R

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INTERNATIONAL SEARCH REPORT

Information on patent family members

Internat Application No
PCT/GB 97/01042

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		CA 2157036 A	01-09-94
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